

# Inclusive Innovation Systems

How innovation intermediaries can  
strengthen the innovation system

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# Inclusive Innovation Systems: How innovation intermediaries can strengthen the innovation system

## I. BACKGROUND

### Poverty and the BoP concept

While the world has welcomed its 7 billionth human inhabitant, more than half of these people are living in poverty. Efforts of organizations like the World Bank, the UN, NGO's and numerous bilateral development agencies have contributed to a decrease in extreme poverty over the last decades (World Economic Forum, 2009). However, as is obvious from World Bank data, much remains to be done. Since early 2000's a new concept has emerged in the fight against poverty. Prahalad, and with him other scholars and practitioners, have argued that the private sector can play a major role in reducing poverty by doing business with the BoP, or the *Base of the Pyramid*<sup>1</sup> (C. K. Prahalad, 2005).

The BoP describes the roughly 4 billion people who live of less than \$2/day (C. K. Prahalad, 2011). They have mostly been ignored as consumers. According to Prahalad however, it is possible to serve the poor profitably through low margins and high volumes (C. K. Prahalad, 2005). BoP markets around the world represent a combined value of about 5 trillion dollar in purchasing power parity (World Resource Institute & International Finance Corporation, 2007). The promise of the BoP concept is twofold. First, companies can make profits while doing business with the poor. Second, by providing products and services to the poor, they are offered an improved livelihood and a chance to escape poverty (C. K. Prahalad, 2005).

### Inclusive business and Inclusive Innovation

Many organizations have since engaged in developing what are called 'inclusive business models'. Inclusive business is about including low-income communities in the value chain, thereby positively influencing both income and access to markets (Gradl & Knobloch, 2010). Innovation in this context has known several names and definitions, for instance 'Gandhian' (C. Prahalad & Mashelkar, 2010), or 'frugal' (The Economist, 2010) innovation. A recent and more elaborate definition has emerged around the term *inclusive innovation*, which refers to innovation processes that specifically address the needs of the BoP and involve the BoP not only as consumer, but also as producer, employee, and entrepreneur. The outcomes of these processes are high performance products, services and processes that combine availability, accessibility, affordability and acceptability. Innovation in this

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<sup>1</sup> Originally, BoP referred to '*Bottom of the Pyramid*'. Due to the negative connotation to '*bottom*', it is now more common to refer to the '*Base of the Pyramid*' instead.

context refers to the successful exploitation of an idea. Successful in the sense that it has a positive impact on the BoP in a financially and environmentally sustainable way. In these processes the private sector is the preferred leading actor, but academia, knowledge institutes, not-for-profit organizations and public authorities are also key stakeholders (Chevrollier, 2012). The term has as of yet not been clearly defined in literature, therefore, to formulate a clear and complete definition is one of the goals of this research.

### **Successes at the BoP**

Since the first notion of the BoP concept in the early 2000's, the world has seen several prime examples of BoP innovation. The telecom industry in India proved that BoP innovation can be high-tech, by providing mobile banking services to the poor in Kenya (Wooder & Baker, 2011). The Indian telecom industry proved to be able to sell airtime at extremely low margins while also fostering some of the most profitable businesses in India (C. K. Prahalad, 2009), the adoption rate of mobile technology was unheard of in Western context. These and other examples spurred the enthusiasm among scholars, governments and the private sector. At the same time though, many attempts to innovate for the poor fail. The difficulties in aligning innovation processes to BoP markets and environments prevents these innovations to reach sufficient scale to impact the BoP (Gradl & Jenkins, 2011).

## **II. PROBLEM DESCRIPTION**

BoP markets are mostly found in the least developed countries, mainly in Africa and Asia, but also in Eastern Europe and Latin America. The environments in these countries often lack the institutional, informational and infrastructural conditions required to make markets work (Gradl & Jenkins, 2011). Innovation is therefore hampered by the conditions found in these challenging environments.

### **Supporting BoP innovation**

Despite the difficulties, the promises of successful BoP -or inclusive- innovation keep attracting governments, the private sector and not-for-profit organizations. Western governments increasingly tend to move away from bilateral aid and towards investing in private sector development in and for BoP markets. To this end, governments, and with them not-for-profits, knowledge institutes and investment funds seek ways to support inclusive innovation. It is in this context that *innovation intermediaries* emerge. An innovation intermediary is defined as “an organisation formally engaged in coordinating and facilitating innovation processes between two or more parties and which may also engage in a variety of functions related to the many aspects of innovation” (Kilelu, Klerkx, & Leeuwis, 2011, p. 13). In the BoP context it is an organisation that specifically aims to steer more innovative efforts towards the BoP, to support innovators in overcoming the difficulties related to BoP markets, and to aggregate knowledge about these processes. These intermediaries seek to develop tools and

instruments to fill the institutional voids and overcome the institutional distance between BoP and home markets experienced by private enterprises. In order to develop these instruments, the intermediaries need to have a clear understanding of innovation processes in BoP context, and of what barriers are experienced by private sector actors. A more detailed definition and typology of innovation intermediaries and its origins is given in the following section.

### III. LITERATURE REVIEW

In both science and policy circles, it is widely recognized that innovations are best understood as the outcome of innovation systems (Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007). The study of inclusive innovation can therefore benefit from the progress that has been made in this respect in the field of innovation management. In this chapter a short literature review is presented which summarizes the properties and advantages of such an approach. Furthermore, this chapter reviews some literature on systemic instruments and the role of innovation intermediaries.

#### **Innovation Systems**

The term ‘innovation systems’ (IS) was first coined in the 1980’s and further developed in the decades after by scholars like Freeman (1995), Edquist (1999), Lundvall (1988) and Carlsson and Stankiewicz (1999). The main line of thought is that determinants of technological change are not only found in individual firms, but also in the societal structures that surround them (Suurs, 2009). An innovation system consists of actors and institutions, and the relationships between them. Actors are the system components that perform innovation activities. Institutions are passive and can be regarded as the rules, regulations, routines and cultural norms that influence innovative activity of actors, and are in turn influenced by it (Carlsson & Stankiewicz, 1991; Carlsson, Jacobsson, Holmén, & Rickne, 2002; Edquist & Hommen, 1999; Markard & Truffer, 2008; Suurs, 2009) As Markard and Truffer state: “Actors may thus be regarded as the players, and institutions as the rules of the game” (Markard & Truffer, 2008, p. 445)<sup>2</sup>.

The innovation systems approach is considered to have several advantages over other approaches. It does not regard technological change as exogenous, it rather places the innovation process at the heart of what is being studied (B. Johnson, Edquist, & Lundvall, 2003). Secondly, it is a holistic approach, encompassing not only economic but also political and social determinants. And thirdly, it emphasizes interdependency and non-linearity (Carlsson et al., 2002). The performance of an innovation system is not a linear function of its elements, but rather the product of the numerous

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<sup>2</sup> There is some confusion on the concept ‘institution’. While it has above been defined as passive ‘rules’, some authors use it to refer to organizations like universities (B. Johnson et al., 2003). In this research *institution* refers to the former, unless stated otherwise.

relations between its elements (Suurs, 2009). The outcome of the system is determined by the weakest elements of the innovation system (Smits & Kuhlmann, 2004; Suurs, 2009).

### **Types of Innovation Systems**

Scholars have developed different ideas of innovation systems. The type of innovation system defines the boundaries of the system, and the type of innovations under study. The narrower the definition, the more restricted the focus becomes to the institutions and actors that are directly relevant to innovation (AU-NEPAD, 2010). Perhaps the most widely used type of IS is the National System of Innovation. First coined by Freeman in 1982, it builds on the work of Friedrich List in the late 19<sup>th</sup> century (Freeman, 1995). It is used by organizations like the OECD, European Union, UNIDO and AU-NEPAD for policymaking and between-country analysis (B. Johnson et al., 2003). Its boundaries are geographically determined, and the approach has a strong focus on formal institutions and the role of governments (B. Johnson et al., 2003). Other geographically defined systems may be local, regional or supranational (B. Johnson et al., 2003).

IS can also be 'sectorally' defined. The boundaries of these systems are not geographical, but are related to a specific product or group of products with a similar function; a specific technology; or a particular industry (Bo Carlsson et al., 2002; B. Johnson et al., 2003). For instance 'sectoral innovation systems' (Breschi and Malerba, 1997), or 'technological systems' (Carlsson & Stankiewicz, 1991).

A technological innovation system (TIS) is defined as "a combination of interrelated sectors and firms, a set of institutions and regulations characterizing the rules of behavior and the knowledge infrastructure connected to it" (Hekkert et al., 2007, p. 416). As actors relevant to a technology connect across industries and across borders, there is no geographical delineation.

### **Functions of Innovation Systems**

In more recent literature, specific attention has been given to 'functions' of innovation systems (Suurs, 2009). The idea behind this approach is that the system is considered to have a purpose, and that this purpose can be served through the fulfilment of a set of functions (Bergek, 2002). The single-most important purpose of an innovation system is to induce innovation processes (Suurs, 2009). All activities that contribute to the creation and diffusion of innovation are considered system functions (Hekkert et al., 2007; Suurs, 2009). System functions can be understood as types or sets of activities that contribute to the overall innovation process of a system (Suurs, 2009).

This approach is considered to have two key advantages. Most systemic analysis only allow for a static or *snapshot* view of a system, by focusing on system components. As a functional analysis of innovation systems consists of mapping events and activities over time, it allows the researcher to gain insight in system dynamics (Hekkert et al., 2007; A. Johnson, 2001; Suurs, 2009). It is expected

that functions influence each other, and that feedback loops could exist. If relations and feedback loops of systemic functions are understood, there is an opportunity to identify how an innovation system can be steered towards a self-strengthening and cumulative state (Suurs, 2009). Secondly, it offers a way to analyse the performance of the system using different variables than diffusion rates (Suurs, 2009). The performance, or functioning of the system, can then be expressed in how well the functions have been served (A. Johnson, 2001).

Different scholars have defined different lists of functions in different kind of systems (Bergek, 2002; Carlsson and Jacobsson, 2004; Edquist, 2004; Hekkert et al., 2007). Yet in essence, these lists vary very little. Hekkert et al. (2007), building on the TIS approach, proposed a list of seven system functions. These functions are:

- Entrepreneurial Activities
- Knowledge Development
- Knowledge Diffusion
- Guidance of the Search
- Market Formation
- Resource Mobilisation
- Support from Advocacy Coalitions

### **Systemic instruments**

The goal of such a functional approach, as is for most innovation system approaches is to arrive at policy recommendations. Smits and Kuhlmann (2004) argue that policy is increasingly directed at the system level of innovation. They have therefore introduced the concept of *systemic instruments*, being policy instruments designed to deal with system imperfections (Smits & Kuhlmann, 2004). A list of five functions of systemic instruments is then defined: (1) management of interfaces, (2)(de-) construction and organising (innovation) systems, (3) providing a platform for learning and experimenting, (4) providing an infrastructure for strategic intelligence, and (5) stimulating demand articulation, strategy and vision development.

It is in recent literature that several approaches come together. Wieczorek and Hekkert (2012) integrate a functional and structural analysis to identify systemic problems, which lead to accompanying systemic instrument goals for policy-makers. Chapter VI will go into how this approach is used to analyse inclusive innovation.

### **Intermediaries**

In the literature on innovation systems scholars frequently refer to intermediaries, as being one of the relevant actors in an innovation system (Bergek, 2002; Hall, 2005; M. Hekkert et al., 2007; A. Johnson, 2001; Smits & Kuhlmann, 2004; Suurs, 2009; Wieczorek & Hekkert, 2012). Yet many of these scholars

fail to define what such an organization is, and what its specific role in the innovation system is. Klerkx and his colleagues have addressed this issue in several publications (Kilelu et al., 2011; L Klerkx & Leeuwis, 2008a, 2008b; Laurens Klerkx & Leeuwis, 2009). Innovation intermediation is distinguished from knowledge brokering, as it encompasses more than transferring knowledge between actors. It is a more complex role in which longer-term relational innovation capabilities are offered, on individual actor level as well as on system level (Kilelu et al., 2011). They also argue that the role of innovation intermediaries is particularly important in developing countries, as they have been noted to have rather weak innovation systems with sporadic and fragmented linkages. Batterink et al. (2010) specify a particular type of intermediaries as being innovation brokers, which aim only at enabling other organizations to innovate. Kilelu et al. (2011) however found that in the context of developing countries, these dedicated innovation brokers are rare, and tend to be involved in a broader range of activities. I therefore choose to follow the definition of Kilelu et al. (2011) of innovation intermediaries being organisations engaged in coordinating and facilitating innovation processes between two or more actors and which may also engage in a variety of functions related to the many aspects of innovation.

#### **IV. THEORETICAL FRAMEWORK**

The innovation systems approach is a good starting point for the study on inclusive innovation. Yet as inclusive innovation has many aspects that are distinct from the innovation processes that are mainly studied in the Western context, it is appropriate to formulate a more narrow definition of the innovation system. I will therefore introduce the notion of the *Inclusive Innovation System*.

##### **Inclusive Innovation Systems**

I will use this section to define the Inclusive Innovation System (IIS). The IIS is built up of four structural elements being actors, institutions, interactions, and infrastructure. The combined objective of the IIS is to reach as much positive impact on the BoP through inclusive innovations as possible. An inclusive innovation is defined as the successful exploitation of an idea into a high performance product, service or process that combines availability, accessibility, affordability and acceptability, and which positively impacts the lives of people at the BoP in a financially and environmentally sustainable way.

##### **IIS actors**

The actors in an IIS are all those organizations that perform inclusive innovation, or innovative activities directed at the BoP. The definition of inclusive innovation designates the private sector as the preferred leading actor. Most IIS are found in developing countries, in these countries local markets are often dominated by informal private actors (Arocena & Sutz, 2005; Gradl & Jenkins, 2011). Private sector actors constitute local firms, foreign firms and multi-national corporations

(MNCs). Non private sector actors are academia, knowledge institutes, not-for-profit organizations, intermediaries and public authorities. Civil society is also an actor, in an IIS this mainly constitutes of the BoP, or those that live of less than US\$ 2 per day. They are part of the innovative process as consumer, producer, employee and entrepreneur.

### **IIS institutions**

Institutions are the 'rules of the game'. In Western markets institutions are often clear to system actors. Formalized or hard institutions like rules, standards and laws are well documented, complied to and enforced. System actors have also developed instruments to monitor informal or soft institutions, like norms, culture, beliefs and routines through marketing agencies and consumer panels. Furthermore, system actors are typically locally embedded, thereby having a deep understanding of informal institutions. In most IIS however, there is far less clarity on institutions. There are less formalized institutions, and there is less rigour in compliance and enforcement (Farashahi & Hafsi, 2009). Additionally, many actors are operating outside their home markets, therefore not having the same degree of embeddedness and cultural understanding (Hart & London, 2005). Market information is typically rare, out-dated, or incorrect, and difficult and costly to gather.

### **IIS interactions**

The term interaction is used to refer to the relations between actors. Interactions can be strong, weak or absent. Interactions are found on the level of individual actors and on the level of networks.

### **IIS infrastructure**

An IIS has a physical infrastructure, these are the roads, bridges, railways, harbours, telecoms etc. It also has a knowledge infrastructure, which is the knowledge, know-how etc. that is present in the system. And it has a financial infrastructure which includes financial programs, subsidies etc.

### **Boundaries**

A particular IIS can be defined around a single product or technology (e.g. domestic biogas plant) a group of products fulfilling a particular function (e.g. cook stoves), a sector (e.g. energy), or sub-sector (e.g. horticulture). Boundaries can then be set by selecting a specific target group (e.g. rural households) or a specific geographic region (e.g. Vietnam) to make sure that across the IIS institutions that matter to the innovation under study are homogeneous. Cultural beliefs in Kenya can for instance be very different from cultural beliefs in Nepal, thus even though it is the same technology, and perhaps even the same actors, the institutions that influence the innovation process are very different, and should thus be regarded as a different IIS. It can however also be that the institutions that matter are similar for specific target groups in different geographic regions, for instance the position of women in Somalia can be similar to that of women in Indonesia, an IIS can then be defined by target group (e.g. women in Islamic countries).



### **Who's in, who's out?**

In are all those actors that are active in the development and diffusion of a specific technology, product-group or within a certain sector, thereby specifically (not exclusively) targeting the poor. The geographic boundaries are defined not in the strict sense that all actors need to be present within these borders, yet their activities do need to target the poor within the geographically defined area. It therefore for instance does include the Dutch firm that is developing a new milling technology specifically for the poor, but it does not include the firm that builds general components, as its innovative activity does not specifically targets the poor. That is not to say that this actor does not interact with actors within the system, and through that interaction they can even influence the system (e.g. through an increase or decrease in prices of certain components), however this is regarded as an influence exogenous to the system.

## **V. RESEARCH QUESTIONS**

It is desirable to be able to accelerate innovation, as innovation is regarded as the driver of long-term economic growth (M. Hekkert et al., 2007). It is also desirable to be able to steer innovation in a certain direction, to support stringent societal needs (M. Hekkert et al., 2007) like poverty-alleviation. Governments of countries where many BoP markets are found are not sufficiently able to influence innovation systems in order to accelerate and steer innovation. Therefore, there is a need for other parties to do this. I argue that innovation intermediaries can play a substantial role in strengthening the Inclusive Innovation System. The question then becomes:

### ***How can innovation intermediaries strengthen Inclusive Innovation Systems in BoP markets?***

I will answer this question by analysing a particular IIS, the Inclusive Innovation System of AgroFood in Vietnam (see next chapter for a rationale of this case-selection). The first sub-question is then:

*Sub-question 1: What is the structure of the AgroFood IIS in Vietnam?*

The second sub-question will go into identifying weaknesses of the IIS. Functions can be lacking completely, or can be fulfilled insufficiently:

*Sub-question 2: How are the system functions being fulfilled?*

The third sub-question will combine the findings of questions in 1 and 2:

*Sub-question 3: What systemic problems can be identified?*

The fourth sub-question will bring us to the recommendations for the innovation intermediaries on how to strengthen the inclusive innovation system:

*Sub-question 4: What instruments need to be developed to strengthen the Inclusive Innovation System?*

## VI. METHODS

While the study of innovation systems is not new, the notion of inclusive innovation and the inclusive innovation systems framework are. Furthermore, the body of literature on the BoP concept is still fairly thin. The research is thus more one of theory building than of theory testing. Qualitative research is therefore preferred over quantitative research (Bryman & Bell, 2007).

### Case study research

Case studies have strengths and weaknesses, which I will not discuss in full length; it suffices to state why the case study method is appropriate for this research. An exploratory case study is the preferred method when “a ‘how’ or ‘why’ question is being asked about a contemporary set of events, over which the investigator has little or no control” (Yin, 2002, p.9). In his book on case study research, Yin seems to have been aware of the use of case study methods in the area of Innovation Systems: “Case studies are found even in economics, in which the structure of a given industry or the economy of a city or a region may be investigated by using the case study method” (Yin, 2002, p.1).

The research will follow the design of an embedded, single-case design. The single-case being the Inclusive Innovation System, and embedded referring to the multiple units of analysis that are embedded in the case study, the inclusive innovation system components. The choice for a single-case design over a multiple-case design follows two rationales. First, the size and nature of inclusive innovation systems, or that of any innovation system, mean that due diligence is required for its study; it is therefore simply a matter of practicality. Second, although each inclusive innovation system is unique, the selection of a *typical* inclusive innovation system legitimizes the choice for a single-case study. It is assumed that the lessons from this case are informative about other cases as well.

### Case selection

The Inclusive Innovation System that is being studied is defined around the AgroFood sector in Vietnam. This sector is chosen because it is a sector that is present in all BoP markets, and is rich in both opportunities and challenges. Vietnam is chosen because it is a country that has proven to be one of the fastest growing economies in Asia, yet the benefits of this economic growth do not sufficiently trickle down to those who need it most. To impact the lives of people at the BoP, a

different kind of growth is needed. It is argued that inclusive innovation can provide this kind of growth.

The embedded units of analysis in this case study are actors from within the Inclusive Innovation System. This actor-oriented analysis is chosen as it is assumed that recommendations that follow from such an analysis come closer to the perceived reality of these actors, and are therefore more likely to lead to follow-up from firms and intermediaries. A number of key-actors are chosen as representing the IIS.

### **Case description**

Vietnam is easily associated with war, and Vietnam has known many. After being colonized by the French, conquered by the Japanese, then split in North and South through civil war, it got into perhaps one of the most televised wars when US troops landed in the early sixties. While the Americans left, and North and South were reunited in 1976, battles long and short were fought with China and Pol Pots Khmer Rouge of Cambodia until 1989. These hostilities and communist rule had long isolated Vietnam from the international community. It was not until the mid 90's that all international relations were normalised.

The isolation, wars and planning economy have also had its effects on the economy. Two decades ago Vietnam was one of the poorest countries in Asia. The Doi Moi policy of 1986, which means 'renovation' in Vietnamese, restructured the economy towards a "socialist-oriented market economy". The last decade the Vietnamese economy grew at a steady 7% per year, and it is now underway to become a middle-income country. Poverty however is still widespread, and almost half of the population lives below the poverty line of US\$ 2 per day, 90% of these poor live in rural areas.

Agriculture is perhaps the most important sector to the Vietnamese economy, as it makes up 20% of its GDP. Nearly half of the population depends on agriculture for their livelihoods (FAO, 2011). Vietnam is mainly a producer of commodities – it is the world's second largest rice exporter – with relatively little value added processing. Opportunities for impacting the BoP can mainly be found in three sub-sectors: dairy, aquaculture, and vegetable cultivation.

### **Data collection**

Three sources of evidence will be used. 1) Documentation like annual reports and annual (policy) plans. 2) Interviews will form the core of the analysis. The interviews will be held with key informants from within and around the IIS. These interviews will take the form of guided conversations rather than structured queries. 3) Direct observations of the actors and the environment in which they operate. To gather this evidence, a field trip to Vietnam is planned for April and May 2012. In this time several people representing different types of actors will be interviewed. Interviewees will be

identified and approached through the network of the BoP Innovation Center. A Dutch not-for-profit organization whose aim is to learn about, develop and accelerate BoP innovation, and which has enabled me to get familiar with this subject through an extensive internship.

### Data analysis

In both data collection and data analysis a system perspective will be taken. The framework as proposed by Wieczorek and Hekkert (2012) will be used to analyse the system. First an analysis is made of the structure of the IIS. Then an assessment is made of the functioning of the system. For the evaluation of the functions the key actors are subjected to questions regarding that function (see annex A), and together with the actors the functions are scored on a 5-level scale (0=absent, 1= very weak, 2=weak, 3=moderate, 4=strong, 5=very strong) (Wieczorek & Hekkert, 2012).

Then for all of the functions that are not or not sufficiently being fulfilled it will be determined which of the structural elements causes this. It can be caused by the absence of a structural element, but also to the *quality* of the structural element. This quality is referred to as capabilities when we speak of an actor problem, as capacity when we speak of an interaction problem, as intensity when we speak of an institutional problem and as quality when we speak of an infrastructural problem. Each type of problem has an accompanying systemic instrument goal. This analysis is shown in table 1.

Systemic Function	Structural Element	Systemic Problem	(Type of) systemic problem	Systemic instrument goals
F1: entrepreneurial activities	Actors	Actor Problems	Presence?	Stimulate and organise the participation of relevant actors
			Capabilities?	Create space for actors capability development
	Interactions	Interaction problem	Presence?	Stimulate occurrence of interactions
			Intensity?	Prevent too strong and too weak ties
	Institutions	Institutional problem	Presence?	Secure presence of hard and soft institutions
			Capacity?	Prevent too weak and too stringent institutions
	Infrastructure	Infrastructural problem	Presence?	Stimulate physical, financial and knowledge infrastructure
			Quality?	Ensure adequate quality of infrastructure

Table 1: Inclusive Innovation System analysis (taken from Wieczorek and Hekkert 2012)

The outcome then is a list of systemic instrument goals related to the seven functions. Some of these systemic instrument goals will be suitable to be picked up by intermediaries.

The research design is shown in figure 1. In table 2 for each activity the status and planning is given.

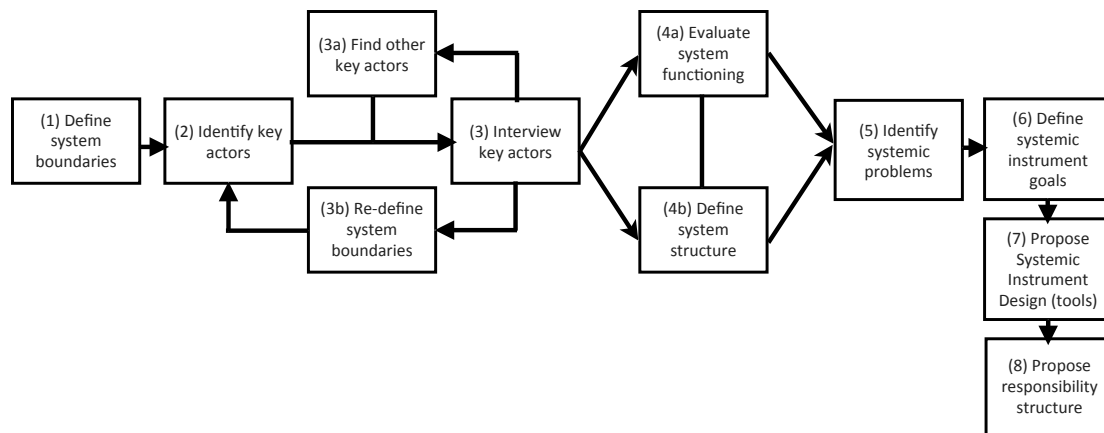


Figure 1: Research Design

No	Activity	When?	Status	Remarks
1	Define system boundaries	End of March	Completed	System boundaries are defined around three subsectors: aquaculture, horticulture, and dairy. Can be adjusted based on early interviews (see 3b)
2	Identify key actors	Early April	Initiated	
3	Interview key actors	3 <sup>rd</sup> and 4 <sup>th</sup> week of April	First 2 interviews are planned	Looking to interview as much people from the subsectors as possible, representing or knowledgeable on components of the specific system
3a	Find other key actors	3 <sup>rd</sup> and 4 <sup>th</sup> week of April		Interviewees will be asked if they can refer to other important actors
3b	Re-define system boundaries	3 <sup>rd</sup> week of April		If necessary, system boundaries are redefined (for instance, when actors refer to other important actors that are outside current system boundaries)
4a	Evaluate system functioning	4 <sup>th</sup> week of April, 1 <sup>st</sup> week of May		
4b	Evaluate system structure	4 <sup>th</sup> week of April, 1 <sup>st</sup> week of May		
5	Identify systemic problems	1 <sup>st</sup> and 2 <sup>nd</sup> week of May		Will be done during field trip when possible, in order to check with actors.
6	Define systemic instrument goals	2 <sup>nd</sup> and 3 <sup>rd</sup> week of May		Can be done after field trip
7	Propose systemic instrument design			(optional) Not yet determined if this is in scope of this research
8	Propose responsibility structure			(optional) Not yet determined if this is in scope of this research

Table 2: Research design

## VII. PLANNING

The planning has mostly been given in table 2. See table 3 for the planning of supervision per activity.

Month	Student	Supervision (40 hours)
January, February	Prepare proposal	10
February, March	Prepare site visits and interviews	5
April	Case study research	0
May	Data analysis	10
June	Writing thesis	10
July	Finalizing thesis	5

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## Annex A

### Function 1, entrepreneurial activities:

- Are there enough entrepreneurs?
- What is the quality of entrepreneurship?
- What types of businesses are involved?
- What are the products?
- To what extent do entrepreneurs experiment?
- What variety of technological options are available?
- Are any entrepreneurs leaving the system?
- Are there new entrepreneurs?

### Function 2, knowledge development:

- What is the knowledge base in terms of quality and quantity?
- Is the knowledge basic or applied?
- Are there many projects, research, patents and articles?
- Is there a leading international position, trigger programmes, many cited patents?
- Which actors are particularly active?
- Who finances the knowledge development?
- Does the technology receive attention in national research and technology programs?
- Are there enough knowledge users?

### Function 3, knowledge dissemination:

- Are there strong partnerships?
- Between whom?
- Is the knowledge development demand-driven?
- Is there space for knowledge dissemination?
- Is there strong competition?
- Does the knowledge correspond with the needs of the innovation system?
- Have any licenses been issued?

### Function 4, guidance of the search:

- Is there a clearly articulated and shared goal for the system?
- Is it generic or specific?
- Is it supported by specific programs, policies, who are the system's frontrunners?
- Is the objective inducing government activities?
- What are the technological expectations (negative / positive)?
- Does the articulated vision fit in the existing legislation?

### Function 5, market formation:

- What does the market look like?
- What is its size (niche/developed)?
- Who are the users (current and potential)?
- Who takes the lead (public/private parties)?
- Are there institutional incentives/barriers to market formation?
- Must a new market be created or an existing one be opened up?

### Function 6, resources mobilisation:

- Are there sufficient financial resources for system development?
- Do they correspond with the system's needs?
- What are they mainly used for (research/application/ pilot projects etc.)?
- Is there sufficient risk capital?
- Is there adequate public funding?
- Can companies easily access the resources?

### Function 7, creation of legitimacy:

- Is investment in the technology seen as a legitimate decision?
- Is there much resistance to change?
- Where is resistance coming from?
- How does this resistance manifest itself?
- What is the lobbying power of the actors in the system?
- Is coalition forming occurring?